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by a finite number of deductions. This mathematical rigor which we require does not necessitate complicated demonstrations ; the most rigorous method is often the simplest and the easiest to comprehend.

The conceptions of arithmetic or those of analysis are not the only ones susceptible of rigorous treatment. Those of geometry and the physical sciences are equally so, provided that by means of a complete system of assumptions they are as well fixed as the conceptions of arithmetic.

When a problem presents serious difficulties, by what methods can we attack it ?

First by *generalization*, in attacking the problem considered to a group of questions of the same order. (*E. g.* Introduction of ideal numbers into the theory of algebraic numbers ; employment of complex paths in the theory of definite integrals).

Or else by *specialization*, in deepening the study of more simple analogous problems already solved.

The failure of attempts at the solution of a problem comes often from the problem being impossible to solve under the form given. Then we require a rigorous *demonstration of the impossibility*. (Parallel postulate, quadrature of the circle, algebraic solution of the equation of the fifth degree.)

We say that a conception exists from the mathematical point of view when the assumptions which define it are compatible, that is to say when a finite chain or system of logical deductions starting from these assumptions can never lead to a contradiction.

Mathematics in developing, far from losing its character of unique science, manifests it from day to day more clearly. Each real progress brings necessarily the discovery of methods more incisive and more simple, permitting to each geometer an access relatively facile to all the parts of our science.

The magnificent reception given by the President of France M. Loubet and his wife Madame Emilie Loubet in which the members of the Congress participated, was only surpassed in charm by the delightful entertainment given in our honor by Prince Roland Bonaparte.

DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ARITHMETIC.

130. Proposed by H. C. WHITAKER, M. E., Ph. D., Professor of Mathematics, Manual Training School, Philadelphia, Pa.

How many balls 1 inch in diameter can be put in a cubical box 2 feet in the clear each way, putting in the maximum number ?

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

$$31 \times \frac{1}{2} \sqrt{2} + 1 = 22.9201.$$

Hence, we can put in 32 layers; 16 layers of 576 in each layer and 16 layers of 529 in each. There still remains space enough for one more layer.

$$23 \times \frac{1}{2} \sqrt{3} + 1 = 20.918.$$

Hence, in this layer, we can put 3 rows of 24 balls each and 24 rows of 24 and 23 alternately, or 636 in the whole layer.

$$\therefore 16 \times 576 = 9216$$

$$16 \times 529 = 8464$$

$$1 \times 636 = 636$$

$$\text{Total} = 18316$$

II. Solution by MARTIN H. SPINKS, Wilmington, Ohio.

Take the bottom layer and the rows in equilateral triangular form. The distance between the rows is .866 inch. The number of rows $= 1 + (23 \div .866) = 1 + 26 = 27$.

We then have 14 rows, 24 balls each, or 336 balls, and 13 rows, 23 balls each, or 299 balls each.

The bottom layer contains $336 + 299$ or 635 balls. In the next layer we have 14 rows of 23 balls each or 322 balls, 13 rows of 24 balls each or 312 balls, in all 634 balls.

Distance between layers = .8162 inch.

Number of layers $= 1 + (23 \div .8162) = 28 + 1 = 29$.

Space left $= 24 - (1 + 28 \times .8162) = .1464$ inch.

\therefore We have 15 layers, 635 balls each, or 9525 balls

and 14 layers, 634 balls each, or 8876 balls

$$\text{Total} = 18401 \text{ balls.}$$

NOTE. Excellent solutions of problem 129 were received from H. C. Whitaker, P. S. Berg, G. B. M. Zerr, Martin Spinks, J. Scheffer, and O. S. Westcott. Mr. Gruber also furnished a non-rythmical solution. We think that his poetical solution is sufficiently clear and accurate as to be easily understood. The results of the various contributors differ slightly from Mr. Gruber's and from each other.

ALGEBRA.

106. Proposed by ELMER SCHUYLER, B. Sc., Professor of German and Mathematics, Boys' High School, Reading, Pa.

$$\frac{x^2 + x}{y^2 + y} = a; \quad \frac{x^2 + y}{y^2 + x} = b; \quad \text{find } x \text{ and } y.$$

I. Solution by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tenn.; L. B. FILLMAN, Chester, Pa.; and the PROPOSER.

By composition and division we have at once

$$\frac{x^2 + x + y^2 + y}{x^2 - y^2 + x - y} = \frac{a + 1}{a - 1} \dots (1), \quad \frac{x^2 + y + y^2 + x}{x^2 - y^2 + y - x} = \frac{b + 1}{b - 1} \dots (2).$$